

OPINION

by: Prof. Nikolay Ivanov Stoimenov, Ph.D.,
Institute of Information and Communication Technologies
at the Bulgarian Academy of Sciences,
member of the scientific jury by Order No. 179/01.07.2026 of the Director of IICT

*on a dissertation for obtaining the
educational and scientific degree "Doctor (Ph.D.)"*

Author of the dissertation thesis: Genka Ivanova Slavova-Torres

Thesis of the dissertation: "Methods and Means for Optimization of Write Operations in a Storage Area Network"

Field of higher education: 5. Technical Sciences

Professional field: 5.3. Communication and Computer Engineering

Doctoral programme: "Computer Systems, Complexes and Networks"

Scientific supervisor: Assoc. Prof. Vladimir Ivanov, Ph.D.

General characteristics of the dissertation

The dissertation thesis presented to me for an opinion has a volume of 147 pages and is structured into an introduction, six chapters, a conclusion, a list of contributions, references, a declaration of originality and an appendix. It contains 24 figures and 16 tables. A total of 67 literature sources are cited, predominantly foreign sources, including foundational works on queueing theory and recent publications on data storage architectures.

1. Relevance of the problem addressed in the dissertation in scientific and scientific-applied terms

The dissertation addresses a topical and practically significant area — the optimization of write operations in storage area networks (SAN). The transition from mechanical disks to SSD and NVMe/NVMe-oF increases the nominal speed of the media but does not remove the problem of predictability of write latency, since the limiting factor shifts from the medium to the management of queues along the write path.

The author directs the research towards tail latency rather than towards averaged indicators. This choice has direct practical significance: for transactional systems, databases and virtualized platforms, the stability and predictability of response time are more important than peak throughput. The relevance of the subject is further confirmed by the growing publication activity in the field.

2. Degree of familiarity with the state of the problem and creative interpretation of the literature

The literature review covers 67 sources and combines classical works on queueing theory and computer systems performance analysis with recent publications on SAN architectures, NVMe-oF and latency behaviour. The author traces the evolution of bottlenecks in storage

subsystems and on this basis formulates the research thesis — that sustainable optimization depends on the alignment between workload characteristics and queue management mechanisms along the entire write path, and not solely on the nominal speed of the components.

The aim and the nine specific tasks of the research are derived in a well-argued manner following the review. The candidate is familiar in detail with the state of the field under consideration and possesses the capacity required to obtain new results.

3. Correspondence between the chosen research methodology, the stated aim and tasks of the dissertation, and the achieved contributions

The research methodology is built consistently: a conceptual model of the write path as a multi-stage system of interacting queues (Chapter 2), an experimental framework with clearly separated fixed and variable parameters (Chapter 3), a baseline scenario and four experiments (Chapter 4), and an analytical synthesis with an optimization framework (Chapter 5).

Chapter 3 contains a separate section on what is not measured and why. Explicitly delimiting the boundaries of measurement is a mark of methodological discipline and is rarely encountered in dissertations in this area.

The chosen approach corresponds to the stated aim and tasks, and the results obtained correspond to the formulated scientific and scientific-applied contributions.

4. Scientific and scientific-applied contributions of the dissertation

I accept the contributions formulated by the author, which are of a scientific, scientific-applied and applied nature, and assess them positively. A certain degree of consolidation could be made.

The contributions consist in: the development of a systemic representation of the write path in a SAN environment, interpreted through the principles of queueing theory; an analytical model distinguishing the regimes of controlled parallelism, transition zone and coordination stress; an experimental methodology for the analysis of latency behaviour through empirical cumulative distribution functions and tail percentiles (p95 and p99); the experimental establishment of the relationship between I/O queue depth, workload shape, coordination of request submission and the presence of a competing host on the one hand, and latency stability on the other; as well as an optimization framework that converts observed behaviour into concrete management actions.

5. Assessment of the publications related to the dissertation

Six publications have been presented in connection with the dissertation, of which four are single-authored and two are co-authored with the scientific supervisor. Two of the single-authored publications appear in international scientific forums referenced and indexed in world-renowned databases. The remaining ones appear in an academic journal and in the proceedings of the international conference Robotics, Automation and Mechatronics.

The publications reflect, present and disseminate the main parts of the dissertation. It may be concluded that the results have become known and accessible to the scientific community.

6. Opinions, recommendations and remarks

The dissertation is well structured, developed in detail, and is distinguished by thoroughness and a consistent effort to arrive at a workable solution. The area under investigation offers potential for further development.

I have one substantive remark. In part of the presentation of the experimental results, it is not distinguished clearly enough which values are directly measured and which are obtained through model-based extension. I would ask that this be clarified during the defence.

As a recommendation concerning the review part, I would note that the 67 literature sources examined are sufficient to substantiate the research thesis, but for a field with such intensive publication dynamics their number could be greater

As a recommendation for future research activity, I suggest that the developed framework be validated in a real production environment with more than two competing hosts and across different classes of hardware. This would make it possible to verify to what extent the established threshold between controlled parallelism and coordination stress holds outside controlled experimental conditions.

I also recommend that the candidate increase her publication activity in scientific journals with an impact factor and/or SJR rank.

The dissertation contains spelling and technical inaccuracies — duplicated numbering of section 3.8, an incorrect internal reference in Table 7, a repetition in the text of contribution No. 6, and an inconsistency in the year of one of the bibliographic entries. The section “Author’s publications on the dissertation”, listed in the table of contents, is not set out in the main body. I have shared these inaccuracies with the doctoral candidate. The inaccuracies do not diminish the value of the dissertation.

CONCLUSION

The dissertation contains scientific and scientific-applied results that constitute an original contribution to science, and demonstrates that the candidate possesses in-depth theoretical knowledge in the respective specialty and the ability to conduct independent scientific research. The requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria, of the Regulations for its implementation, and of the Regulations on the specific conditions for obtaining scientific degrees and holding academic positions at IICT-BAS have been met. The stated aim has been achieved.

On the basis of my acquaintance with the dissertation and the materials relating to it, the fulfilled educational objective of the doctoral studies, the relevance of the subject and the significance of the scientific and scientific-applied contributions achieved, I confidently give a positive assessment of the dissertation work of Genka Ivanova Slavova-Torres.

I recommend to the honourable Scientific Jury to award Genka Ivanova Slavova-Torres the educational and scientific degree “Doctor (Ph.D.)” in the field of higher education 5. Technical Sciences, professional field 5.3. Communication and Computer Engineering, doctoral programme “Computer Systems, Complexes and Networks”.

Sofia, 09.09.2026

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